I PROJECT OVERVIEW

The Burke-Gilman Trail Redevelopment project consists of widening the existing Burke-Gilman Trail through the City of Lake Forest Park and providing where feasible a soft surface trail adjacent to the main trail. The overall length of the proposed improvements is approximately 2.2-miles.

This drainage analysis gives preliminary findings related to the capacity analysis of culverts crossing the Burke-Gilman trail, including a hydrologic analysis of the upstream drainage basins for each culvert in order to estimate the peak 25-year and 100-year flow rates at each culvert crossing.

II BACKGROUND

There are 14 drainage basins associated with 17 culvert crossings of the Burke-Gilman Trail. In addition, there are 2 bridge crossings that convey McAleer and Lyon Creeks under the trail, that are part of a larger basin area that have been studied extensively in the past by King County. As a result of these studies, several CIP projects have been constructed to reduce flooding. Further analysis based on a regional drainage basin study may be required to address predicted peak flows and conveyance capacity of the bridge crossings under the trail and is not part of this study.

<u>Conveyance:</u>
The Burke-Gilman Trail follows an abandoned railroad grade and is nearly flat for the two-mile stretch of the proposed redevelopment project. The trail is generally located at the toe of a steep slope, except within the McAleer and Lyon Creek basins where the surrounding topography is mainly flat upstream and gently sloping toward Lake Washington on the downstream side.

The existing conveyance system along the Burke-Gilman Trail is made up of a network of drainage ditches running parallel to the trail on the upstream side, interconnected with cross culverts which convey seepage and runoff across the trail to Lake Washington. Runoff and seepage that makes its way to these culvert crossings is generated upstream of the trail and is conveyed to the trail in a number of ways, including storm drainage piping, manmade ditches and natural drainage courses. Surface water runoff originates from rainfall and other precipitation falling within the drainage basin. Impervious surfaces such as roadways and roof contribute to the amount of runoff generated in each drainage basin. A discussion of how runoff from these surfaces is calculated is included in the methodology section of this analysis.

As part of the redevelopment and widening of the trail, the existing cross culverts will be analyzed to determine if they have adequate capacity to convey flows across the trail, and prevent flooding of the trail.

Flow Control:
Per the 2005 King County Surface Water Design Manual, this project is eligible for a direct discharge exemption from flow control. Criteria for this exemption is listed in section 1.2.3, page 1-30 of the manual. Lake Washington is a major receiving water body, and may receive direct discharge of surface water runoff. As such, no flow control facilities have been designed.

Water Quality Treatment:
Per the definition given on page 15 of the 2005 King County Surface Water Design Manual, the Burke-Gilman Trail is not a pollution generating impervious surface. Therefore, water quality treatment is not required for the improved area.

III METHODOLOGY

Existing Hydrology
The drainage analysis for this project was done per the KCRTS/Runoff Files Method described in Chapter 3 of the 2005 King County Surface Water Design Manual (KCSWDM). Runoff time series files were generated using 15-minute timesteps and a full historical record as required by table 3.2.2.A of the design manual. Impervious and pervious areas were calculated using GIS parcel data, and the guidelines in chapter 3 of the design manual. The following is a brief summary of the hydrologic analysis. Please note, as-built drawings of SR-522 were used to help determine drainage basin boundaries. The majority of runoff from SR-522 is conveyed in a piped system to McAleer and Lyon Creeks, upstream of crossing the Burke-Gilman Trail.

1. Culvert crossings of the trail were identified using the site survey and site visit for additional verification. In all, 17 culvert crossings and 2 bridges have been identified.
2. Upstream drainage basins for each culvert were mapped using topographic and drainage information provided by GIS mapping and as-built drawings of SR-522 provided by WSDOT. In all, 14 drainage basins draining to culvert crossings were identified. Some basins are drained by more than one culvert, and therefore there are fewer basins than culvert crossings. .
3. Using the GIS database, zoning within each mapped drainage basin was identified. The zoning was categorized into three groups: Single Family Residential (SF), Multi-Family/Commercial (MF/COM), and ROW.
4. The ROW area was divided and applied using a weighted average to either the SF grouping, or the MF/COM grouping.

5. For the SF areas within each sub-basin, the number of dwelling units per gross acre was calculated. Then, using Table 3.2.2.D of the KCSWDM, the percent impervious area was found. Next, the effective impervious fraction (EIF) from Table 3.2.2.E of the KCSWDM was used to give the total impervious area for the single family residential (SF) areas within each sub-basin. All pervious area was considered grass for this analysis.
6. For MF/COM areas within each drainage basin, a total impervious area of 90% was estimated based on an aerial photograph of the basins. Then, an EIF of 95% from Table 3.2.2.E was applied to the impervious areas. All pervious area was considered as grass for this analysis.
7. The impervious and pervious areas was totaled per sub-basin, and input into KCRTS using 15 minute timesteps and the full historical record.

Existing Conveyance Capacity of Culverts Crossing Trail:

A separate conveyance capacity analysis was completed for each culvert crossing of the Burke-Gilman Trail. Some assumptions were made where there was insufficient data from the survey. In particular, many of the outfalls were unable to be located due to their location on private property. All culverts where there was no survey information and we were unable to locate the inlet or outlet a minimum slope of 1% was applied. Manning's equation was used to calculate the full flow capacity of each culvert. Manning's equation was used to calculate flow based on cross-sectional area of pipe, pipe slope, and a roughness coefficient, which was assigned based on the type of pipe material. A smoother pipe (such as concrete or PVC) will have a greater capacity to convey stormwater than a corrugated pipe such as CMP.

IV FINDINGS

The capacity of each culvert was compared with the peak flows from the corresponding tributary drainage basin. The following table summarizes the results:

Culvert #	Culvert Capacity (cfs)	Drainage Basin #	Design Flow 25-year (cfs)	Design Flow 100-year (cfs)
1	16.0	1	20.8	37.3
1a	55.4	1a	1.7	2.5
2	25.1	2	7.2	12.8
3	22.6	3	7.8	13.0
4	22.6	4	2.9	4.7
5	22.6	5	3.4	5.5
6	66.7	6	4.0	6.0
7	33.2	7	2.8	4.2
8a	insufficient data	*8	175.7	311.2
8b	insufficient data			
8c	insufficient data			
9	36.1	9	11.6	17.8
10	36.1	10	16.2	24.3
11a	22.6	*11	6.5	10.8
11b	1.9			
12	10.5	12	6.0	10.0
13	3.6	13	1.2	2.1

*Basins 8 and 11 are drained by multiple culverts. A more detailed analysis is needed of basin 8 to determine culvert capacity.

Based on the results shown above, culvert number 1 may be undersized, and may need to be upgraded as part of the redevelopment of the trail. This will need to be analyzed in more detail during the final design. Also, the capacity of culverts draining basin 8 will need a more detailed evaluation during the final design phase since there is insufficient data based on the survey to determine the capacity of the existing culvert crossings for the drainage basin.

Drainage Basins Map